DESCRIPTION

SEPARATOR

Technical Field

The present invention relates to a separator provided in a stack-type polymer electrolyte fuel cell.

Background Art

Conventionally, there have been widely recognized needs for efficient use of limited energy resources and energy saving for prevention of global warming. Today, energy demand is met by thermal power generation in such a manner that thermal energy is converted into electric power energy.

However, coal and oil required for the thermal power generation are resources of which reserves are finite, so that new energy resources are now necessary to replace the coal and oil with. Given this factor, attentions have been drawn to a fuel cell which chemically generates power with use of hydrogen for fuel.

The fuel cell has two electrodes and an electrolyte disposed between the electrodes. In the anode, supplied hydrogen is ionized to be a hydrogen ion

separator which enhances productivity and realizes a high yield.

The invention provides a separator which is interposed between a plurality of electrolyte assemblies each constructed of an electrolyte layer containing an electrolyte medium and a catalytic electrode disposed on a surface in a thickness-wise direction of the electrolyte layer, the separator comprising:

a separating section for achieving separation between a fuel gas channel and an oxidizer gas channel; and

a sealing section disposed along an outer periphery of the separator, for preventing leakage of fuel gas and oxidizer gas,

wherein the separating section is composed of a flat metal sheet serving as a core member, and a resin layer formed on a surface of the flat metal sheet,

the resin layer is provided with the channel,

the sealing section is composed of a metal sheet and a rubber layer formed on a surface of the metal sheet, and provided with a sealing projection extending in parallel with a surface of the electrolyte assembly on which a catalytic electrode is formed, the sealing section having a vertex which is constituted so as to be brought into pressure-contact with the electrolyte

assembly under a resilient force, and

the sealing projection has a circular arc-shaped sectional profile when viewed in a direction perpendicular to a direction in which the fuel gas and the oxidizer gas flow.

According to the invention, the invention provides a separator which is interposed between a plurality of electrolyte assemblies each constructed of an electrolyte layer containing an electrolyte medium and a catalytic electrode disposed on a surface in a thickness-wise direction of the electrolyte layer, the separator having a separating section for achieving separation between a fuel gas channel and an oxidizer gas channel.

In the separating section, on a surface of the flat metal sheet serving as a core member is formed a resin layer that is, for example, a rubber layer in which a channel is provided.

Further, the separator has a sealing section disposed along an outer periphery of the separator, for preventing leakage of fuel gas and oxidizer gas. The sealing section is composed of a metal sheet and a rubber layer formed on a surface of the metal sheet, and provided with a sealing projection extending in parallel with a surface of the electrolyte assembly on which a catalytic electrode is formed, the sealing section having

a vertex which is constituted so as to be brought into pressure-contact with the electrolyte assembly under a resilient force. The sealing projection has a circular arc-shaped sectional profile when viewed in a direction perpendicular to a direction in which the fuel gas and the oxidizer gas flow.

Accordingly, by providing the flat metal sheet for a core member, it is possible to provide a separator which has less warp and deformation volume and is excellent in reliability, compared to a separator consisting solely of rubber. Since the metal sheet serving as a core member is covered with the resin layer, it is possible to prevent surface changes such as corrosion caused by hydrogen gas and oxygen gas, and coolant.

Further, it is possible to eliminate the need to prepare a sealing member such as an O-ring or a gasket that has conventionally been required to effect sealing, and thereby reduce the number of constituent components of a fuel cell.

Further, the invention provides a separator which is interposed between a plurality of electrolyte assemblies each constructed of an electrolyte layer containing an electrolyte medium and a catalytic electrode disposed on a surface in a thickness-wise

direction of the electrolyte layer, the separator comprising:

a separating section for achieving separation between a fuel gas channel and an oxidizer gas channel; and

a sealing section disposed along an outer periphery of the separator, for preventing leakage of fuel gas and oxidizer gas,

wherein the separating section is composed of a flat metal sheet serving as a core member, and a resin layer formed on a surface of the flat metal sheet,

the resin layer is provided with the channel,

the sealing section is composed of a metal sheet and a rubber layer formed on a surface of the metal sheet, and provided with a sealing projection extending in parallel with a surface of the electrolyte assembly on which a catalytic electrode is formed, the sealing section having a vertex which is constituted so as to be brought into pressure-contact with the electrolyte assembly under a resilient force, and

the sealing projection has a U-shaped or V-shaped sectional profile when viewed in a direction perpendicular to a direction in which the fuel gas and the oxidizer gas flow.

According to the invention, the invention provides

a separator which is interposed between a plurality of electrolyte assemblies each constructed of an electrolyte layer containing an electrolyte medium and a catalytic electrode disposed on a surface in a thickness-wise direction of the electrolyte layer, the separator having a separating section for achieving separation between a fuel gas channel and an oxidizer gas channel.

In the separating section, on a surface of the flat metal sheet serving as a core member is formed a resin layer that is, for example, a rubber layer in which a channel is provided.

Further, the separator has a sealing section disposed along an outer periphery of the separator, for preventing leakage of fuel gas and oxidizer gas. The sealing section is composed of a metal sheet and a rubber layer formed on a surface of the metal sheet, and provided with a sealing projection extending in parallel with a surface of the electrolyte assembly on which a catalytic electrode is formed, the sealing section having a vertex which is constituted so as to be brought into pressure-contact with the electrolyte assembly under a resilient force. The sealing projection has a U-shaped or V-shaped sectional profile when viewed in a direction perpendicular to a direction in which the fuel gas and the oxidizer gas flow.

Accordingly, by providing the flat metal sheet for a core member, it is possible to provide a separator which has less warp and deformation volume and is excellent in reliability, compared to a separator consisting solely of rubber. Since the metal sheet serving as a core member is covered with the resin layer, it is possible to prevent surface changes such as corrosion caused by hydrogen gas and oxygen gas, and coolant.

Further, it is possible to eliminate the need to prepare a sealing member such as an O-ring or a gasket that has conventionally been required to effect sealing, and thereby reduce the number of constituent components of a fuel cell.

Further, the invention is characterized in that on a surface of the resin layer is formed a high conductive layer having higher electrical conductivity than electrical conductivity of the resin layer.

According to the invention, it is possible to decrease a contact resistance between the separator and the electrolyte assembly.

Further, the invention is characterized in that the high conductive layer is formed at least in a region of the resin layer which is in contact with the electrolyte assembly.

According to the invention, the high conductive layer is formed at least in a region of the resin layer which is in contact with the electrolyte assembly, so that a contact resistance between the separator and the electrolyte assembly can be decreased more effectively.

Further, the invention provides a separator which is interposed between a plurality of electrolyte assemblies each constructed of an electrolyte layer containing an electrolyte medium and a catalytic electrode disposed on a surface in a thickness-wise direction of the electrolyte layer, the separator comprising:

a separating section for achieving separation between a fuel gas channel and an oxidizer gas channel; and

a sealing section disposed along an outer periphery of the separator, for preventing leakage of fuel gas and oxidizer gas,

wherein the separating section is composed of a flat metal sheet serving as a core member, and a resin layer and a high conductive layer having higher conductivity than conductivity of the resin layer, which are formed on a surface of the flat metal sheet,

the high conductive layer is provided with the channel,

the sealing section is composed of a metal sheet and a rubber layer formed on a surface of the metal sheet, and provided with a sealing projection extending in parallel with a surface of the electrolyte assembly on which a catalytic electrode is formed, the sealing section having a vertex which is constituted so as to be brought into pressure-contact with the electrolyte assembly under a resilient force, and

the sealing projection has a circular arc-shaped sectional profile when viewed in a direction perpendicular to a direction in which the fuel gas and the oxidizer gas flow.

According to the invention, the invention provides a separator which is interposed between a plurality of electrolyte assemblies each constructed of an electrolyte layer containing an electrolyte medium and a catalytic electrode disposed on a surface in a thickness-wise direction of the electrolyte layer, the separator having a separating section for achieving separation between a fuel gas channel and an oxidizer gas channel.

In the separating section, on a surface of the flat metal sheet serving as a core member are formed a resin layer and a high conductive layer having higher conductivity than conductivity of the resin layer. The high conductive layer is provided with the channel.

Further, the separator has a sealing section disposed along an outer periphery of the separator, for preventing leakage of fuel gas and oxidizer gas. The sealing section is composed of a metal sheet and a rubber layer formed on a surface of the metal sheet, and provided with a sealing projection extending in parallel with a surface of the electrolyte assembly on which a catalytic electrode is formed, the sealing section having a vertex which is constituted so as to be brought into pressure-contact with the electrolyte assembly under a resilient force. The sealing projection has a circular arc-shaped sectional profile when viewed in a direction perpendicular to a direction in which the fuel gas and the oxidizer gas flow.

Accordingly, by providing the flat metal sheet for a core member, it is possible to provide a separator which has less warp and deformation volume and is excellent in reliability, compared to a separator consisting solely of rubber or thermosetting polymer. Since the metal sheet serving as a core member is covered with the resin layer or the thermosetting polymer layer, it is possible to prevent surface changes such as corrosion caused by hydrogen gas and oxygen gas, and coolant. Furthermore, it is possible to decrease a contact resistance between the separator and the

electrolyte assembly and moreover, largely decrease a resistance of entire current passages, so that a rate of power collection can be enhanced.

Further, it is possible to eliminate the need to prepare a sealing member such as an O-ring or a gasket that has conventionally been required to effect sealing, and thereby reduce the number of constituent components of a fuel cell.

Further, the invention provides a separator which is interposed between a plurality of electrolyte assemblies each constructed of an electrolyte layer containing an electrolyte medium and a catalytic electrode disposed on a surface in a thickness-wise direction of the electrolyte layer, the separator comprising:

a separating section for achieving separation between a fuel gas channel and an oxidizer gas channel; and

a sealing section disposed along an outer periphery of the separator, for preventing leakage of fuel gas and oxidizer gas,

wherein the separating section is composed of a flat metal sheet serving as a core member, and a resin layer and a high conductive layer having higher conductivity than conductivity of the resin layer, which

are formed on a surface of the flat metal sheet,

the high conductive layer is provided with the channel,

the sealing section is composed of a metal sheet and a rubber layer formed on a surface of the metal sheet, and provided with a sealing projection extending in parallel with a surface of the electrolyte assembly on which a catalytic electrode is formed, the sealing section having a vertex which is constituted so as to be brought into pressure-contact with the electrolyte assembly under a resilient force, and

the sealing projection has a U-shaped or V-shaped sectional profile when viewed in a direction perpendicular to a direction in which the fuel gas and the oxidizer gas flow.

According to the invention, the invention provides a separator which is interposed between a plurality of electrolyte assemblies each constructed of an electrolyte layer containing an electrolyte medium and a catalytic electrode disposed on a surface in a thickness-wise direction of the electrolyte layer, the separator having a separating section for achieving separation between a fuel gas channel and an oxidizer gas channel.

In the separating section, on a surface of the flat metal sheet serving as a core member are formed a

resin layer and a high conductive layer having higher conductivity than conductivity of the resin layer. The high conductive layer is provided with the channel.

Further, the separator has a sealing section disposed along an outer periphery of the separator, for preventing leakage of fuel gas and oxidizer gas. The sealing section is composed of a metal sheet and a rubber layer formed on a surface of the metal sheet, and provided with a sealing projection extending in parallel with a surface of the electrolyte assembly on which a catalytic electrode is formed, the sealing section having a vertex which is constituted so as to be brought into pressure-contact with the electrolyte assembly under a resilient force. The sealing projection has a U-shaped or V-shaped sectional profile when viewed in a direction perpendicular to a direction in which the fuel gas and the oxidizer gas flow.

Accordingly, by providing the flat metal sheet for a core member, it is possible to provide a separator which has less warp and deformation volume and is excellent in reliability, compared to a separator consisting solely of rubber or thermosetting polymer. Since the metal sheet serving as a core member is covered with the resin layer or the thermosetting polymer layer, it is possible to prevent surface changes such as

corrosion caused by hydrogen gas and oxygen gas, and coolant. Furthermore, it is possible to decrease a contact resistance between the separator and the electrolyte assembly and moreover, largely decrease a resistance of entire current passages, so that a rate of power collection can be enhanced.

Further, it is possible to eliminate the need to prepare a sealing member such as an O-ring or a gasket that has conventionally been required to effect sealing, and thereby reduce the number of constituent components of a fuel cell.

Further, the invention is characterized in that the high conductive layer is a thin film formed of carbon, the high conductive layer being formed through spraying of a dispersion of carbon particles.

According to the invention, the dispersion of carbon particles is sprayed to form a thin film formed of carbon. This makes it possible to form the high conductive layer in a very simple process.

Further, the invention is characterized in that the metal sheet is covered with a covering layer.

Further, the invention is characterized in that, the covering layer is formed on the metal sheet surface via an adhesive layer.

Further, the invention is characterized in that

the adhesive layer is formed of triazinethiol or polyaniline diffused on the metal sheet surface.

According to the invention, the covering layer is formed on the metal sheet surface via the adhesive layer. In more detail, a diffusion layer which will serve as the adhesive layer is formed on the metal sheet surface through application of a coating of an electrically conductive coupling agent typified by a triazinethiol-base compound, as well as a coating of doped electrically conductive polymer typified by a polyaniline-base compound. The triazinethiol- or polyaniline-base compound diffused over the metal surface exhibits electrical conductivity, thus ensuring electrical conductivity with respect to the resin layer so as to take out a generated DC power as a DC current.

Further, the invention is characterized in that the covering layer is formed of rubber or synthetic resin having electrical conductivity, and

wherein the electrically conductive ink contains:

a vehicle composed of thermosetting monomer or thermosetting oligomer for forming the rubber or synthetic resin; and

an electrically conductive filler composed of a metal compound or carbon-base material.

According to the invention, by covering the

surface of the metal sheet with the rubber and synthetic resin having electrical conductivity, it is possible to prevent the surface changes and moreover, to ensure the electrical conductivity between the metal sheet and the resin layer. Further, the resin layer can be realized by carrying out the printing by use of the electrical conductive ink containing the vehicle composed of thermosetting monomer or thermosetting oligomer for forming the rubber or synthetic resin, and the electrically conductive filler composed of a metal compound or carbon-base material.

Brief Description of Drawings

Objects, features, and advantages of the invention will be more explicit from the following detailed description taken with reference to the drawing wherein:

Fig. 1 is an exploded perspective view schematically showing a polymer electrolyte fuel cell (PEFC for short) 100;

Fig. 2 is a horizontal sectional view of a unit cell 101 including a separator 1;

Fig. 3 is a view of assistance in explaining a shape of a sealing section 14 designed for generating a resilient force;

Fig. 4 is an enlarged view illustrating the main

portion of a separating section 13 according to a first embodiment;

Fig. 5 is an enlarged view illustrating the main portion of the sealing section 14 according to the first embodiment;

Fig. 6 is an enlarged view illustrating the main portion of the separating section 13 according to a second embodiment;

Fig. 7 is an enlarged view illustrating the main portion of the sealing section 14 according to the second embodiment;

Fig. 8 is an enlarged view illustrating the main portion of the separating section 13 according to a third embodiment;

Fig. 9 is an enlarged view illustrating the main portion of the separating section 13 according to a fourth embodiment;

Fig. 10 is an enlarged view illustrating the main portion of the separating section 13 according to a fifth embodiment;

Fig. 11 is an enlarged view illustrating the main portion of the sealing section 14 according to the fifth embodiment;

Fig. 12 is a manufacturing process view showing the manufacturing method of the separator;

Fig. 13 is an enlarged view illustrating the main portion of the separating section 13 according to a sixth embodiment;

Fig. 14 is an enlarged view illustrating the main portion of the sealing section 14 according to of the sixth embodiment;

Fig. 15 is an enlarged view illustrating the main portion of the separating section 13 according to a seventh embodiment;

Fig. 16 is an enlarged view illustrating the main portion of the separating section 13 according to an eighth embodiment;

Fig. 17 is an enlarged view illustrating the main portion of the sealing section 14 according to the eighth embodiment;

Fig. 18 is a manufacturing process view showing the manufacturing method of the separator;

Fig. 19 is an enlarged view illustrating the main portion of the separating section 13 according to a ninth embodiment;

Fig. 20 is an enlarged view illustrating the main portion of the sealing section 14 according to the ninth embodiment;

Fig. 21 is an enlarged view illustrating the main portion of the separating section 13 according to a tenth

embodiment;

Fig. 22 is a manufacturing process view showing the manufacturing method of the separator;

Fig. 23 is a horizontal sectional view of the unit cell 101 including the separator 1 of another shape;

Fig. 24 is a horizontal sectional view of the unit cell 101 including the separator 1 of another shape; and

Fig. 25 is a schematic sectional view of the separator 1 obtained in Example 7.

and a stainless-steel sheet having an electrically conductive compound coated by means of an ion plating process.

The sealing section 14 is provided with a sealing projection extending in parallel with the surface on which the catalytic electrode 21 is formed. The sealing projection has a U-shaped or V-shaped sectional profile when viewed in a direction perpendicular to the direction in which a gaseous substance flows. By providing a metal thin sheet for the core member of the separator 1, a vertex 18 of the sealing projection is brought into pressure-contact with the exposed part of the polymer membrane 20 under a resilient force. At the position of pressure-contact therebetween, sealing is effected to prevent leakage of hydrogen gas and oxygen gas. Moreover, by imparting a U-shaped or V-shaped configuration to the sealing projection, it is possible to reduce the area of contact between the vertex 18 and the polymer membrane, and thereby achieve a high-pressure sealing effect as achieved in the case of using an O-ring.

In order to bring the vertex 18 of the sealing projection into pressure-contact with the polymer membrane 20 successfully under a resilient force, the sealing section 14 is previously formed in a manner such

have electrical conductivity and moreover needs to be able to be formed through printing. The resin layer 42 is formed in such a manner that electrically conductive ink containing a vehicle composed of thermosetting monomer or thermosetting oligomer, and an electrically conductive filler composed of a metal compound or carbon-base material, is prepared to conduct pattern printing onto a covering layer 41 by means of predetermined printing method. This will be described in detail hereinafter.

Fig. 11 is an enlarged view illustrating the main portion of the sealing section 14 according to the fifth embodiment. In the sealing section 14, the covering layer 41 makes contact with the polymer membrane 20 to effect sealing. The sealing section 14 is formed by a press work..

Fig. 12 is a manufacturing process view showing the manufacturing method of the separator.

The manufacturing process includes a base processing step, an ink preparing step, a resin layer printing step, a resin layer hardening step, and a sealing section forming step.

In order to realize a shape of partition block as shown in Fig. 2, it is necessary to conduct thick film printing such that a thickness of printed ink falls in a

needs to be able to be provided with a channel molded therein by use of the stamper. First of all, a composition containing a binder composed of thermosetting monomer, thermosetting oligomer, or thermosetting prepolymer, and an electrically conductive filler composed of a metal compound or a carbon-base material, is prepared so that the electrically conductive green sheet is formed. This electrically conductive green sheet is laminated on the surface of the metal thin sheet and then, the electrically conductive green sheet is molded so as to have the concavity and convexity formed therein by use of the stamper (mold) provided with a predetermined transfer pattern, with the result that the resin layer 42 is formed.

Fig. 17 is an enlarged view illustrating the main portion of the sealing section 14 according to the eighth embodiment. In the sealing section 14, the metal thin sheet 40 makes contact with the polymer membrane 20 to effect sealing. The sealing section 14 is formed by a press work..

Fig. 18 is a manufacturing process view showing the manufacturing method of the separator.

The present manufacturing process includes a base processing step, a composition preparing step, a

transferring property from the stamper was favorable. Further, as shown in Fig. 2, the obtained mechanical characteristics and electric characteristics were enough for functions as a separator.

Fig. 22 is a manufacturing process view showing the manufacturing method of the separator.

In the present embodiment, the electrically conductive green sheet is not employed, but electrically conductive slurry is applied to the surface of the metal thin sheet and dried to form a coating layer, and the coating layer is molded so as to have the concavity and convexity formed therein by use of a stamper, with the result that the resin layer 42 provided with the channels is formed. Since the resin layer 42 needs to have electrical conductivity, rubber or synthetic resin containing an electrically conductive filler can be used for the resin layer 42. Particularly, the rubber preferably used includes polyisobutylene, and the synthetic resin preferably used includes epoxy resin and acrylate resin, and more preferably used is resin having a structure of interpenetrating polymer network (abbreviate as IPN) in which the epoxy resin and the acrylate resin are combined. Further, the resin layer 42 is formed once as a coating layer made of the dried

changes such as corrosion caused by hydrogen gas and oxygen gas, and coolant.

Further, it is possible to eliminate the need to prepare a sealing member such as an O-ring or a gasket that has conventionally been required to effect sealing, and thereby reduce the number of the constituent components of a fuel cell.

Further, according to the invention, it is possible to decrease a contact resistance between the separator and the electrolyte assembly.

Further, according to the invention, the high conductive layer is formed at least in a region of the resin layer which is in contact with the electrolyte assembly, so that a contact resistance between the separator and the electrolyte assembly can be decreased more effectively.

Further, according to the invention, a dispersion of carbon particle is sprayed to form a thin film formed of carbon. This makes it possible to form the high conductive layer in a very simple process.

Further, according to the invention, the separating section and the sealing section are integrally formed, so that it is possible to reduce the number of manufacturing process steps of the fuel cell.

Further, according to the invention, by covering

the surface of the metal sheet with the rubber and synthetic resin having electrical conductivity, it is possible to prevent the surface changes and moreover, to ensure the electrical conductivity between the metal sheet and the resin layer. Further, the resin layer can be realized by carrying out printing by use of electrical conductive ink containing vehicle composed of thermosetting monomer or thermosetting oligomer for forming the rubber or synthetic resin, and an electrically conductive filler composed of a metal compound or carbon-base material.

CLAIMS

1. (Amended) A separator which is interposed between a plurality of electrolyte assemblies each constructed of an electrolyte layer containing an electrolyte medium and a catalytic electrode disposed on a surface in a thickness-wise direction of the electrolyte layer, the separator comprising:

a separating section for achieving separation between a fuel gas channel and an oxidizer gas channel; and

a sealing section disposed along an outer periphery of the separator, for preventing leakage of fuel gas and oxidizer gas,

wherein the separating section is composed of a flat metal sheet serving as a core member, and a resin layer formed on a surface of the flat metal sheet,

the resin layer is provided with the channel,

the sealing section is composed of a metal sheet and a rubber layer formed on a surface of the metal sheet, and provided with a sealing projection extending in parallel with a surface of the electrolyte assembly on which a catalytic electrode is formed, the sealing section having a vertex which is constituted so as to be brought into pressure-contact with the electrolyte assembly under a resilient force, and

the sealing projection has a circular arc-shaped sectional profile when viewed in a direction perpendicular to a direction in which the fuel gas and the oxidizer gas flow.

2.(Amended) A separator which is interposed between a plurality of electrolyte assemblies each constructed of an electrolyte layer containing an electrolyte medium and a catalytic electrode disposed on a surface in a thickness-wise direction of the electrolyte layer, the separator comprising:

a separating section for achieving separation between a fuel gas channel and an oxidizer gas channel; and

a sealing section disposed along an outer periphery of the separator, for preventing leakage of fuel gas and oxidizer gas,

wherein the separating section is composed of a flat metal sheet serving as a core member, and a resin layer formed on a surface of the flat metal sheet,

the resin layer is provided with the channel,

the sealing section is composed of a metal sheet and a rubber layer formed on a surface of the metal sheet, and provided with a sealing projection extending in parallel with a surface of the electrolyte assembly on

which a catalytic electrode is formed, the sealing section having a vertex which is constituted so as to be brought into pressure-contact with the electrolyte assembly under a resilient force, and

the sealing projection has a U-shaped or V-shaped sectional profile when viewed in a direction perpendicular to a direction in which the fuel gas and the oxidizer gas flow.

3.(Amended) The separator of claim 1 or 2, wherein on a surface of the resin layer is formed a high conductive layer having higher electrical conductivity than electrical conductivity of the resin layer.

4.(Amended) The separator of claim 3, wherein the high conductive layer is formed at least in a region of the resin layer which is in contact with the electrolyte assembly.

5.(Amended) A separator which is interposed between a plurality of electrolyte assemblies each constructed of an electrolyte layer containing an electrolyte medium and a catalytic electrode disposed on a surface in a thickness-wise direction of the electrolyte layer, the separator comprising:

a separating section for achieving separation between a fuel gas channel and an oxidizer gas channel; and

a sealing section disposed along an outer periphery of the separator, for preventing leakage of fuel gas and oxidizer gas,

wherein the separating section is composed of a flat metal sheet serving as a core member, and a resin layer and a high conductive layer having higher conductivity than conductivity of the resin layer, which are formed on a surface of the flat metal sheet,

the high conductive layer is provided with the channel,

the sealing section is composed of a metal sheet and a rubber layer formed on a surface of the metal sheet, and provided with a sealing projection extending in parallel with a surface of the electrolyte assembly on which a catalytic electrode is formed, the sealing section having a vertex which is constituted so as to be brought into pressure-contact with the electrolyte assembly under a resilient force, and

the sealing projection has a circular arc-shaped sectional profile when viewed in a direction perpendicular to a direction in which the fuel gas and the oxidizer gas flow.

6.(Amended) A separator which is interposed between a plurality of electrolyte assemblies each constructed of an electrolyte layer containing an electrolyte medium and a catalytic electrode disposed on a surface in a thickness-wise direction of the electrolyte layer, the separator comprising:

a separating section for achieving separation between a fuel gas channel and an oxidizer gas channel; and

a sealing section disposed along an outer periphery of the separator, for preventing leakage of fuel gas and oxidizer gas,

wherein the separating section is composed of a flat metal sheet serving as a core member, and a resin layer and a high conductive layer having higher conductivity than conductivity of the resin layer, which are formed on a surface of the flat metal sheet,

the high conductive layer is provided with the channel,

the sealing section is composed of a metal sheet and a rubber layer formed on a surface of the metal sheet, and provided with a sealing projection extending in parallel with a surface of the electrolyte assembly on which a catalytic electrode is formed, the sealing

section having a vertex which is constituted so as to be brought into pressure-contact with the electrolyte assembly under a resilient force, and

the sealing projection has a U-shaped or V-shaped sectional profile when viewed in a direction perpendicular to a direction in which the fuel gas and the oxidizer gas flow.

7. (Amended) The separator of any one of claims 3 to 6, wherein the high conductive layer is a thin film formed of carbon, the high conductive layer being formed through spraying of a dispersion of carbon particles.

8. (Amended) The separator of any one of claims 1 to 7, wherein the metal sheet is covered with a covering layer.

9. (Amended) The separator of claim 8, wherein the covering layer is formed on the metal sheet surface via an adhesive layer.

10. (Amended) The separator of claim 9, wherein the adhesive layer is formed of triazinethiol or polyaniline diffused on the metal sheet surface.

11. (Amended) The separator of any one of claims 8 to 10,

wherein the covering layer is formed of rubber or synthetic resin having electrical conductivity, and

wherein the electrically conductive ink contains:

a vehicle composed of thermosetting monomer or thermosetting oligomer for forming the rubber or synthetic resin; and

an electrically conductive filler composed of a metal compound or carbon-base material.

12. (Canceled)

13. (Canceled)

14. (Canceled)

15. (Canceled)

16. (Canceled)

17. (Canceled)

18. (Canceled)

19. (Canceled)

20. (Canceled)

21. (Canceled)

22. (Canceled)

23. (Canceled)

24. (Canceled)

25. (Canceled)

26. (Canceled)

27. (Canceled)

28. (Canceled)

29. (Canceled)

30. (Canceled)

31. (Canceled)

32. (Canceled)